75622.P0007 Patent

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BOARD OF PATENT APPEALS AND INTERFERENCES

In Re Application of:

Jerrell P. Hein

Application No: 09/441,380

Filed: November 16, 1999

For: METHOD AND APPARATUS FOR MONITORING SUBSCRIBER LOOP INTERFACE CIRCUITRY POWER DISSIPATION

Examiner: Singh, Ramnandan P.

Art Unit: 2646

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Supplemental Appeal Brief Under 37 C.F.R. § 41.37

In response to the previously submitted appeal brief, the Examiner withdrew the final rejection and re-opened prosecution. <u>Applicant (Appellant) respectfully requests re-instatement of the appeal and has submitted this supplemental appeal brief in response to the Office Action dated August 25, 2005.</u> Appellant respectfully requests consideration of this Appeal by the Board of Patent Appeals and Interferences.

A petition for a two month extension of time and the appropriate fee accompanies this brief. The petition extends the time period for response until January 25, 2006. Given that the notice of appeal and appeal brief fees have previously been paid, no additional fees are due.

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I. REAL PARTY IN INTEREST

The above-identified application for patent is assigned to Silicon Laboratories, Inc., the real party in interest. Silicon Laboratories, Inc. is a Delaware corporation having a principal place of business at 4635 Boston Lane, Austin, Texas 78735.

II. RELATED APPEALS AND INTERFERENCES

Appellant is unaware of any other related appeals or interferences that may directly affect or be directly affected by or have a bearing on the Board's decision in this pending appeal.

III. STATUS OF THE CLAIMS

Claims 1-16 are pending. Claims 13-16 are allowed. Claims 1-12 are rejected under 35 U.S.C. § 103 as being unpatentable over U.S. Patent No. 4,456,991 of Chea ("Chea") in view of U.S. Patent No. 4,355,341 of Kaplan ("Kaplan")

IV. STATUS OF AMENDMENTS

No amendments have been submitted in response to the Office Action dated August 25, 2005.

V. SUMMARY OF THE INVENTION

A. Overview

Subscriber line interface circuits are typically found in the central office exchange of a telecommunications network. A subscriber line interface circuit (SLIC) provides a communications interface between the digital switching network of a central office and an analog subscriber line. The analog subscriber line connects to a subscriber station or telephone instrument at a location remote

from the central office exchange. The analog subscriber line and subscriber equipment form a subscriber loop.

The interface requirements of a SLIC result in the need to provide relatively high voltages and currents for control signaling with respect to the subscriber equipment on the subscriber loop. A thermal alarm condition may occur if the semiconductor junction of a linefeed component (a subscriber line driver) exceeds a pre-determined temperature. Different linefeed components may have distinct thermal alarm thresholds. In order to determine the semiconductor junction temperature of a linefeed component, the instantaneous power dissipation of the linefeed component is estimated. The estimated instantaneous power dissipation is filtered to generate an estimated junction temperature of the linefeed component.

A summary of the rejected independent claims is provided below.

B. Summary of Claim 1

Claim 1 is drawn to a method for estimating a junction temperature of a linefeed component of a subscriber loop. At least one of a tip and a ring signal are sampled to determine a line voltage and a line current of the subscriber loop. An instantaneous power dissipation of the linefeed component is estimated using the sampled line voltage and sampled line current. The estimated instantaneous power dissipation is filtered to generate the estimated junction temperature of the linefeed component (Specification, p. 13, line 20 - p. 16, line 17; p. 17, lines 4-12; claim 1 as originally filed; Figs. 5, 6, 7)

C. Summary of Claim 5

Claim 5 is drawn to a method for estimating a junction temperature of a *selected* linefeed component of a subscriber loop. (Specification, p. 16, line 18 - p. 17, line 3). A linefeed component is selected from a plurality of linefeed components coupled to a subscriber loop. At least one of the subscriber loop tip and ring signals is sampled to determine a voltage and a current associated with the selected linefeed component. An instantaneous power dissipation of the

selected linefeed component is estimated using the associated voltage and current. The estimated instantaneous power dissipation is filtered to generate an estimated junction temperature of the selected linefeed component (Specification, p. 13, line 20 - p. 16, line 17; p. 17, lines 4-12; claim 5 as originally filed; Figs. 5, 6, 7).

D. Summary of Claim 7

Claim 7 is drawn to an apparatus for estimating the junction temperature of a selected linefeed driver component of a subscriber loop. The apparatus includes an analog-to-digital converter (ADC 520) for sampling at least one of a tip and a ring signal. A power calculator (540) is coupled to calculate an instantaneous power dissipation of a selected linefeed driver component from a plurality of linefeed driver components. The instantaneous power is calculated from the sampled signal and control currents provided to the plurality of linefeed driver components. A filter (550) provides an estimated junction temperature of the selected linefeed driver component from the instantaneous power dissipation. (Specification, p. 13, line 20 - p. 17, line 12; claim 7 as originally filed; Figs. 5, 6, 7).

VI. CHARACTERIZATION OF CITED REFERENCES

Chea includes a disclosure of a controllable active impedance matching circuit for reducing the impedance mismatch between a selected telephone line circuit and a terminal interface of a switching network. (Chea, col. 1, lines 55-61).

Kaplan includes a disclosure of a transistor protection circuit. The circuit monitors the product of output current and output voltage across the protected transistor (Q_P). The circuit provides a feedback signal (34) to reduce the power dissipation of the protected transistor if the logarithm of this product exceeds a pre-determined limit. The logarithm (30) of the product is obtained by summing (18) voltages logarithmically related to each of the output voltage (V_{CE}) and output current (I_C) of the protected transistor. (Kaplan, col. 1, lines 42-61; col. 2, lines 4-38; Fig. 1)

VII. GROUNDS OF REJECTION TO BE REVIEWED UPON APPEAL

A. The rejection of claims 1-12 under 35 U.S.C. § 103 over Chea in view of Kaplan.

VIII. ARGUMENT

A. Statement of Applicable Law

With respect to an obviousness rejection under 35 U.S.C. § 103, three criteria must be met:

> *First,* there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. *Second,* there must be a reasonable expectation of success. *Finally,* the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure

(*In re Vaeck*, 20 USPQ2d 1438; 947 F.2d 488 (Fed. Cir. 1991)(*emphasis added*)

B. Rejection of claims 1-12 under 35 U.S.C. § 103 over Chea in view of Kaplan

Appellant respectfully submits that the Examiner has failed to establish even a *prima facie* case of obviousness under 35 U.S.C. § 103 and therefore claims 1-12 were improperly rejected under 35 U.S.C. § 103 in view of the cited references.

1) No motivation to combine

The Examiner has stated:

> At the time of the invention, it would have been obvious to a person of ordinary skill in the art to combine the temperature determining technique of Kaplan with Chea, Jr. et al.

(08/25/2005 Office Action, p. 3)

Applicant submits that the Examiner has mischaracterized Kaplan again with respect to teaching a "temperature determining technique". Kaplan eliminates temperature differences between various components for accuracy, but Kaplan's circuitry does not determine junction temperatures nor is a specific junction temperature relevant to Kaplan's disclosure. This will be discussed in greater detail below.

The Examiner has also stated:

> The suggestion/motivation for doing so would have been to limit the power dissipation in a transistor (i.e., a component of a subscriber loop shown in Fig. 2 of Chea, Jr. et al) in order to protect such transistor from damage [Kaplan; col. 1, lines 11-13]

(08/25/2005 Office Action, p. 3).

Although the Examiner has cited to Kaplan, the cited portions merely indicate that it is desirable to limit the power dissipation in an output transistor to protect the transistor from damage. The Examiner has failed to identify any such transistor of Chea that is in danger of needing such protection.

In short, appellant submits that 1) Kaplan does not provide the temperature determining functionality asserted by the Examiner, 2) no component of Chea is identified as needing such functionality, and (3) Chea already provides overcurrent protection for components (Chea, col. 10, lines 18-28)

Appellant submits that the only motivation relied upon by the Examiner is the hindsight afforded by appellant's disclosure. There is no motivation to combine the references as proposed by the Examiner.

2) References do not teach or suggest all claim limitations

Contrary to the Examiner's assertions, Kaplan does not teach or disclose determining a semiconductor junction temperature. The temperature discussion cited by the Examiner merely acknowledges that the voltage across a semiconductor junction is temperature sensitive as a precaution to the practitioner. *Kaplan cautions the practitioner to maintain semiconductor junctions of transistors Q11, Q12, Q2 and Q14 at substantially the same temperature* to avoid the

undesired effect of temperature variation between these components that would otherwise affect the logarithmic proportionalities. (Kaplan, col. 4, lines 60- col. 5, line 2). This is not equivalent to determining the temperature of the junctions.

Kaplan calculates the logarithm of the instantaneous power dissipation by summing the logarithms of the current and the voltage across the protected transistor in an analog domain. As noted by Kaplan, the voltage across a semiconductor is proportional to the logarithm of the current and that such voltage is also proportional to temperature. By maintaining the temperature factor the same for the computational components providing inputs to a comparator, Kaplan *eliminates temperature* of the computational components as a concern when comparing logarithms of the instantaneous power and that of a threshold value. *Kaplan does not teach determining the junction temperature (esp. the junction temperature of the linefeed component/protected transistor) as alleged by the Examiner (see, e.g., 08/25/2005 Office Action, p. 3) Thus one could not reasonably expect the purported combination to generate an estimated junction temperature of the linefeed component.*

a) Filtering to generate estimated junction temperature (Claims 1, 5, 7)

None of the cited references, alone or combined, teaches or suggests filtering an estimated instantaneous power dissipation to generate an estimated junction temperature of the linefeed component.

The Examiner has stated:

> Kaplan teaches computing an instantaneous power dissipation (ICxVCE) of transistor QP [Fig. 1; col. 2, lines 15-38], and that the voltage across the semiconductor is proportional to the logarithm of the current therethrough. *Kaplan further discloses determining the temperature of the semiconductor using the voltage across the semiconductor wherein voltage is proportional to temperature* [col. 4, lines 32-63; col. 6, lines 18-25].

(08/25/2005 Office Action, p. 3)(*emphasis added*)

Applicant traverses the Examiner's characterization of Kaplan. The temperature discussion cited by the Examiner merely acknowledges that the voltage across a semiconductor junction is temperature sensitive as a precaution

to the practitioner. *Kaplan cautions the practitioner to maintain semiconductor junctions of transistors Q11, Q12, Q2 and Q14 at substantially the same temperature* to avoid the undesired effect of temperature variation between these components. (Kaplan, col. 4, lines 60- col. 5, line 2). Maintaining the same (unknown) temperature among a number of semiconductor devices is not equivalent to determining the temperature of their junctions, nor is it equivalent to determining the junction temperature of the linefeed component (protected transistor QP).

The cited portion of Kaplan is drawn to eliminating the undesired effect of temperature variation on components providing inputs to the threshold detector (i.e. element 16). The temperatures of Q11, Q12, Q2 and Q14, however, are wholly unrelated to the junction temperature of protected transistor QP which is a load driving device that would need protecting. Kaplan merely discloses that the transistors providing inputs to comparator should be maintained at the same temperature to ensure that they are similarly affected by temperature in order to cancel any temperature variation effects. (Kaplan, col. 4, line 44 through col. 5, line 9).

At best Kaplan generates a logarithmic value proportional to the instantaneous power dissipation. *Kaplan does not filter the estimated instantaneous power dissipation to generate an estimated junction temperature of the linefeed component.*

Appellant submits that *none of the cited references, alone or combined, teaches or suggests filtering the estimated instantaneous power dissipation to generate an estimated junction temperature of the linefeed component.*

In contrast, claims 1, 5, and 7 include the language:

1. A method comprising the steps of:

a) sampling at least one of a tip and a ring signal to determine a line voltage and a line current of a linefeed component of a subscriber loop;

b) estimating an instantaneous power dissipation of the linefeed component using the sampled line voltage and sampled line current; and

c) *filtering the estimated instantaneous power dissipation to generate an estimated junction temperature of the linefeed component.*

(Claim 1)(*emphasis added*)

5. A method comprising the steps of:
a) selecting a selected linefeed component of a plurality of linefeed components coupled to a subscriber loop having a tip signal and ring signal;
b) sampling at least one of the tip and the ring signals to determine a voltage and a current associated with the selected linefeed component;
c) estimating an instantaneous power dissipation of the selected linefeed component using the associated voltage and current; and
d) *filtering the estimated instantaneous power dissipation to generate an estimated junction temperature of the selected linefeed component.*

(Claim 5)(*emphasis added*)

7. A subscriber loop signal processor apparatus, comprising:
an analog-to-digital converter (ADC) for sampling at least one of a tip and a ring signal;
a power calculator coupled to calculate an instantaneous power dissipation of a selected linefeed driver component from the sampled signal and control currents provided to a plurality of linefeed driver components; and
a filter providing an estimated junction temperature of the selected linefeed driver component from the instantaneous power dissipation.

(Claim 7)(*emphasis added*)

Thus applicant submits claims 1, 5, and 7 are patentable under 35 U.S.C. § 103 in view of the cited references. Given that claims 2-4 depend from claim 1, claim 6 depends from claim 5, and claims 7-12 depend from claim 8, appellant submits claims 2-4, 6, and 8-12 are likewise patentable under 35 U.S.C. § 103 in view of the cited references.

b) Selecting linefeed component from a plurality of linefeed components (Claims 5, 7)

None of the cited references, alone or combined, teaches or suggests selectability of linefeed component for computation of the associated estimated junction temperature.

Appellant does not believe that Chea has an analogous set of linefeed components to select from. Nonetheless, to the extent protection is required, appellant submits no selective monitoring is performed. Chea's overcurrent protection circuitry, for example, examines the line current without regard to individual currents through components coupled to the line (Chea, col. 10, lines 18-28). Thus Chea does not teach or suggest the ability to select between different linefeed components for computation of the associated estimated junction temperature.

Kaplan is drawn to circuitry for determining the instantaneous power dissipation of a single transistor using analog circuitry. There is no provision for using the same circuitry to select among a plurality of transistors coupled to the same load, nor is there a provision for using the same circuitry to select among individual transistors each coupled to a different load. Thus Kaplan does not teach or suggest the ability to select between different linefeed components for computation of the associated estimated junction temperature.

Thus none of the cited references, alone or combined, teaches or suggests selectability of linefeed component for computation of the associated estimated junction temperature.

In contrast, claims 5 and 7 include the language:

> 5. A method comprising the steps of:
> a) *selecting a selected linefeed component of a plurality of linefeed components coupled to a subscriber loop having a tip signal and ring signal;*
> b) sampling at least one of the tip and the ring signals to determine *a voltage and a current associated with the selected linefeed component;*
> c) *estimating an instantaneous power dissipation of the selected linefeed component* using the associated voltage and current; and
> d) filtering the estimated instantaneous power dissipation to *generate an estimated junction temperature of the selected linefeed component.*

(Claim 5)(*emphasis added*)

> 7. A subscriber loop signal processor apparatus, comprising:
> an analog-to-digital converter (ADC) for sampling at least one of a tip and a ring signal;

> a power calculator coupled to calculate an instantaneous power dissipation of *a selected linefeed driver component from the sampled signal and control currents provided to a plurality of linefeed driver components;* and
> a filter *providing an estimated junction temperature of the selected linefeed driver component from the instantaneous power dissipation.*

(Claim 7)(*emphasis added*)

Applicant submits claims 5 and 7 are patentable under 35 U.S.C. § 103 in view of the cited references. Given that claim 6 depends from claim 5 and claims 8-12 depend from claim 7, applicant submits claims 6 and 8-12 are likewise patentable under 35 U.S.C. § 103 in view of the cited references.

3) Summary

Claims 1, 5, and 7 are patentable under 35 U.S.C. § 103 in view of the cited references for either: (a) a lack of motivation to combine, or (b) failure of the references to teach or suggest all claim limitations as argued above. Accordingly, given that claims 2-4 depend from claim 1, claim 6 depends from claim 5, and claims 8-12 depend from claim 7, appellant submits claims 2-4, 6, and 8-12 are likewise patentable under 35 U.S.C. § 103 over the cited references.

C. Mischaracterization of references

Although appellant believes that the rejection of claims 1-12 has been overcome, appellant is compelled to additionally traverse some of the characterizations the Examiner has made about the references.

1) <u>Kaplan</u> allegedly teaches a threshold voltage representing an alarm temperature

The Examiner stated

> Kaplan teaches a threshold comparator 16 to compare the voltage sum on conductor 30 to a reference potential VREF supplied on conductor 28 for protecting transistor QP. This threshold voltage represents an alarm temperature [of] the component [Figs. 1-3; col. 2, lines 4-14; col. 2, lines 32-42; col. 4, lines 44-49; col. 5, lines 3-9]

(10/25/2005 Office Action, p. 4)

Upon reviewing the Examiner's citations, appellant was unable to find any reference to the threshold voltage representing an alarm temperature. Clearly, the threshold voltage represents the upper limit of the instantaneous power dissipation for the protected component. The alarm threshold exclusively represents the instantaneous power dissipation (i.e., not the temperature) beyond which the protected component is to be protected. The Examiner is referred to his own citations.

2) *<u>Chea</u> allegedly teaches a timesharing monitoring circuitry*

The Examiner stated:

> Chea, Jr. et al teach timesharing a same monitor circuitry [Fig. 2; col. 7, line 26 to col. 8, line 2] to perform the steps as outlined in claim 1 above in combination with Kaplan. As a result the combination of Chea, Jr. et al and Kaplan can monitor each linefeed component connected to the subscriber line.

(10/25/2005 Office Action, p. 4)

Upon reviewing the Examiner's citations, appellant was unable to find any support for timesharing of any monitoring circuitry. This portion of Chea was directed to level shifters, power amplifiers, and the line feed drive circuitry. The Examiner is referred to his own citations.

3) *<u>Chea's</u> element 22 allegedly provides information representing thermal characteristics of the linefeed component*

Each of the rejections of claims 4, 7, 9, indicate that the Examiner believes <u>Chea's</u> element 22 provides information suitable for representing thermal characteristics or for calculating the junction temperature of a linefeed component. (see, 10/25/2005 Office Action, pgs. 4-5). Appellant submits that <u>Chea's</u> element 22 is a codec/filter. A codec serves the purpose of converting analog voiceband signals from the subscriber line into pulse code modulated (PCM) data for upstream transmission through the telephone digital switching system. The codec also converts PCM data from the digital switching system into an analog signal for downstream transmission to the telephone equipment

(e.g., customer premises equipment such as a telephone). The filter referred to is a low pass filter used to smooth the analog signal created by the decoding of the received PCM from the digital to analog conversion. (see Chea, col. 4, lines 29-43). Appellant submits, the codec/filter does not function to provide any line information that would be suitable for determining thermal characteristics or calculating junction temperatures.

4) Chea allegedly teaches the use of a nonvolatile memory for storing filter parameters

The Examiner has stated:

> Regarding claim 12, Chea, Jr. et al teach a non-volatile memory (NMRAM) wherein parameters and a program could be stored [Fig. 4; col. 12, lines 43-54]

(10/25/2006 Office Action, p. 5)

Appellant's filter parameters are used to define the thermal characteristics of the linefeed component and are necessary for determining the junction temperature of the linefeed component. Appellant submits that Chea's memory is not used for storing such parameters. Chea discloses a loop activity RAM 250 and a control RAM 200. (Chea, col. 11, lines 34 thru col. 12, line 54; Fig. 4). *However, there is no suggestion that Chea's memory is a nonvolatile RAM or that the RAMs could be used for program storage as stated by the Examiner.*

5) Summary

Despite the lack of impact of these last points on the patentability of the claims, appellant is disturbed by the complete lack of support for these characterizations of the prior art. Appellant respectfully requests the Examiner to ensure that there is some support for the characterizations made about the prior art or alternatively eliminate the rejection.

X. CONCLUSION

Appellant respectfully submits that the stated rejections cannot be maintained in view of the arguments set forth above. Appellant respectfully

requests that the Board of Patent Appeals and Interferences direct allowance of the rejected claims 1-12, such that all of claims 1-16 may proceed to allowance.

If there are any issues that can be resolved by telephone conference, the undersigned representative of the appellant may be contacted at **(512) 858-9910.**

Respectfully submitted,

Date: January 25, 2006

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CLAIMS APPENDIX

The claims and their status are presented below.

1. (PREVIOUSLY PRESENTED) A method comprising the steps of:

a) sampling at least one of a tip and a ring signal to determine a line voltage and a line current of a linefeed component of a subscriber loop;

b) estimating an instantaneous power dissipation of the linefeed component using the sampled line voltage and sampled line current; and

c) filtering the estimated instantaneous power dissipation to generate an estimated junction temperature of the linefeed component.

2. (ORIGINAL) The method of claim 1 further comprising the step of:

d) generating a thermal alarm, if the estimated junction temperature exceeds an alarm threshold.

3. (ORIGINAL) The method of claim 2, further comprising the step of:

e) timesharing a same monitoring circuitry to perform steps a)-d) for each linefeed driver component being monitored.

4. (ORIGINAL) The method of claim 1 further comprising the step of:

d) programming a filter with filtering parameters corresponding to thermal characteristics of the linefeed component.

5. (PREVIOUSLY PRESENTED) A method comprising the steps of:

a) selecting a selected linefeed component of a plurality of linefeed components coupled to a subscriber loop having a tip signal and ring signal;

b) sampling at least one of the tip and the ring signals to determine a voltage and a current associated with the selected linefeed component;

c) estimating an instantaneous power dissipation of the selected linefeed component using the associated voltage and current; and

d) filtering the estimated instantaneous power dissipation to generate an estimated junction temperature of the selected linefeed component.

6. (ORIGINAL) The method of claim 5 further comprising the step of

e) providing a thermal alarm indicator, if the estimated junction temperature exceeds an alarm threshold.

7. (ORIGINAL) A subscriber loop signal processor apparatus, comprising:

an analog-to-digital converter (ADC) for sampling at least one of a tip and a ring signal;

a power calculator coupled to calculate an instantaneous power dissipation of a selected linefeed driver component from the sampled signal and control currents provided to a plurality of linefeed driver components; and

a filter providing an estimated junction temperature of the selected linefeed driver component from the instantaneous power dissipation.

8. (ORIGINAL) The apparatus of claim 7 further comprising:

a comparator providing an alarm indicator if the estimated junction temperature exceeds an alarm threshold.

9. (ORIGINAL) The apparatus of claim 7 further comprising:

a multiplexer coupling the at least one tip and ring signal to the analog-to-digital converter to enable providing an estimated junction temperature of any of the linefeed components using a same ADC, power calculator, and filter.

10. (ORIGINAL) The apparatus of claim 9 wherein a multiplexer control is time based to enable time-sharing the same ADC, power calculator, and filter for each linefeed component.

11. (ORIGINAL) The apparatus of claim 7 wherein the ADC, the power calculator, and the filter reside within a same integrated circuit package.

12. (ORIGINAL) The apparatus of claim 7 further comprising:

a re-writable nonvolatile memory coupled to provide filter parameters corresponding to thermal characteristics of the linefeed components to the filter.

13. (PREVIOUSLY PRESENTED) A subscriber loop interface circuit apparatus comprising:

a signal processor having sense inputs for receiving a sensed tip signal and a sensed ring signal from a tip line and a ring line of a subscriber loop, the signal processor generating subscriber loop control signals; and

a linefeed driver for driving the subscriber loop in accordance with the subscriber loop control signals, the linefeed driver including a tip fuse series-coupled to the tip line and a ring fuse series-coupled to the ring line, wherein the sensed tip signal includes first and second sampled tip voltages sampled from opposing sides of the tip fuse, wherein the sensed ring signal includes first and second sampled ring voltages sampled from opposing ends of the ring fuse.

14. (ORIGINAL) The subscriber loop linefeed driver of claim 13 wherein a difference between the first and second sampled tip voltages is proportional to the tip current, wherein a difference between the first and second sampled ring voltages is proportional to the ring current.

15. (ORIGINAL) A method comprising the steps of:

generating subscriber loop control signals in response to a sensed tip signal and a sensed ring signal of a subscriber loop, wherein the tip signal is sensed before and after a tip fuse, wherein the ring signal is sensed before and after a ring fuse; and

driving the subscriber loop in accordance with the subscriber loop control signals.

16. (ORIGINAL) A subscriber loop interface circuit apparatus comprising:

a signal processor having sense inputs for sensing a tip line and a ring line of a subscriber loop, the signal processor generating subscriber loop control signals; and

a linefeed driver for driving the subscriber loop in accordance with the subscriber loop control signals, the linefeed driver including a tip fuse series-coupled to the tip line and a ring fuse series-coupled to the ring line, wherein the tip line and ring line are each sensed at two locations to determine both a status of each fuse and a power dissipation of each linefeed driver component.

EVIDENCE APPENDIX

This appendix is not applicable.

RELATED PROCEEDINGS APPENDIX

This appendix is not applicable.